



Multivariate Testing Confirms the Effect of Age and Gender Congruence on Click-Through Rates from Online Social Network Digital Advertisements

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Multivariate Testing Confirms the Effect of Age-Gender Congruence on Click-Through
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Age and Gender Congruence Confirmed in Online Advertising

Introduction

A key benefit of web-based technology is the computational ability to target users and customise communication using context-aware approaches and explicit or implicit personalisation techniques.¹ This study uses multivariate testing to assess the extent to which an online ad treatment, that has been designed to be age and gender congruent with the target audience, increases the likelihood of the ad being clicked on. A particularly important feature of this study is that the data are derived from a real-life, real-time digital advertising campaign. This study used the execution of an ad campaign with users whose authentic reactions to the ads were captured. The time bounded ad campaign was hosted on the online social network Facebook, in one region of the United Kingdom.

Background

Personalised messages can be defined as messages that are ‘delivered to each individual user through paid media based on personal information (such as user names, past buying history, demographics, psychographics, locations, and lifestyle interests)’.² Online social media ‘provide web services which facilitate users maintaining a public or semi-public profile within a bounded system’ and through which they can ‘articulate a list of other users with whom they share a connection’.³ On the basis of number of active users worldwide, Facebook remains the largest online social network (Statista, 2017).⁴ According to a 2015 social media marketing industry report only 45% of marketers think that their Facebook efforts are effective.⁵ A particular attribute of advertising on Facebook is its capability to target users of specific gender, age and other criteria. Demographics are the most common variables used to target online users, and age and gender are the most common demographic

variables used due to the ease with which an online user’s gender and age can be determined and used.^{6,7} Tailoring ad content to reflect the demographic profile of the target audience relates to the concept of user congruence.

Congruence is defined as the extent to which content expressions coincide with self-concept⁸ and developing advertising appeals that are congruent with the target’s self-concept is thought to be more effective than appeals which might be deemed incongruent.⁹ Such appeals are considered to reinforce self-concepts¹⁰ and generally “for-me” self-congruent messages are more persuasive than “not-for-me” self-incongruent messages”.¹¹

Hypotheses

The study addresses a number of hypotheses that deal with gender congruence, age congruence and gender and age congruence combined. The hypotheses are grouped according to these variables and the first hypothesis relates to gender congruence solely. As outlined previously, the gender of the central figure in an ad is one factor that effects a process of self-categorising^{12,13} and is one of a number of factors that contributes to overall self-congruence. As such, the H1 hypothesis and its associated hypotheses are shown in Table 1(a).

[Table 1 about here]

Similar to gender congruence, age congruence is another variable contributing to overall self-congruence. And so, the congruency between the model’s age and the audience’s age may

also influence the effect the ad has on the audience.¹¹ Therefore, the H2 hypothesis and its associated hypotheses are shown in Table 1(b).

While it is proposed that gender and age, respectively, will have positive effects on advertising effectiveness, what is of further interest is the combined effect of these two variables. It can be assumed that an ad exhibiting both age and gender congruence will produce the best effects, leading to the H3 hypotheses in Table 1(c). Leading on from these hypotheses emerges the further proposition that either gender or age congruency is better than neither variable being congruent. This extends to the H4 hypotheses dealing with firstly, gender congruency but not age congruency as shown in Table 1(d) and secondly, age congruency but not gender congruency, shown in Table 1(e).

Methodology

The broad design principle of this study is the manipulation of a direct response advertising campaign to allow ad treatments to be varied along two variables: gender and age (of model) and to be served to a population that had been segmented by the same two variables. A two-by-two consumer profile design was combined with multivariate testing to address the hypotheses just outlined.

For this study, in Facebook, we created four campaigns each containing four ad sets. Four ads containing facial imagery reflecting a different age and gender persona were shown equally to four similar populations of cohorts that were targeted at an ad set level within each campaign. We displayed only one ad, reflective of a specific age range and gender persona, in each of the four campaigns.

In order to maximise external validity, it was important to use a real business. The product offering needed to be appropriate to all ages and to both men and women. It was also important that the product offering was such that its depiction within the ads was the same in all four treatments, while ensuring that each resultant ad was realistic. With this in mind, a teeth whitening procedure was selected to be the focus of the ads. The ads were created such that their creative execution differed only by gender or age of the model. Further details on the targeting criteria are provided later. The overall design of the experiment is presented in Figure 1 below.

[Figure 1 about here]

Designing content for the experiment

The ad content was identical in every respect except for the image. Four different images were used which represented one of four different age and gender personas: older female; younger female; older male; younger male. The age and gender of the models included in the images were objectively verified using a publicly available face detection application program interface (API) developed by ‘Face++’.¹⁴ A recent study investigating engagement rates on Instagram found the ‘Face++’ API to show high accuracy.¹⁵ One of the ad treatments (‘older female’) is shown in Figure 2 below.

[Figure 2 about here]

Configuring targeting criteria

A region of the United Kingdom (UK) was selected; the Glasgow metropolitan area (encompassing the surrounding area within a radius of 20 miles). In this region, Facebook can reach 1.2M people aged 18-65+ of a population of 2.3M people. To evaluate the effect of both age and gender congruence, we configured four target groups for each of our ad sets within each Facebook campaign: (1) females aged between 25 and 39, (2) males aged between 25 and 39, (3) females aged between 50 and 64, and (4) males aged between 50 and 64. The campaign was configured to only present ads to recipients along their central line of vision on both desktop and mobile platforms.

We chose an option for ad delivery referred to as 'Daily Unique Reach'. The rationale for choosing this ad delivery option was to ensure that ads were served only once to any Facebook user and not repeatedly, again holding constant another influencing factor on ad effectiveness: number of exposures.¹⁶ The ads within each ad set were configured to run within a scheduled period: a four-hour slot from 14.00 to 18.00 UK time on a Sunday.

Management of the experiment

An overall lifetime budget was set based on the indicated potential population reach (impressions) and a manual bid amount was requested per 1000 impressions i.e. for every 1000 unique members of the population shown an ad. We determined that the total number of ad clicks for all four ad sets within each campaign had to reach a minimum of 400. Since this campaign was for a real business and a real product offering, anyone who clicked on the ad was directed to a landing page that offered more details about the brand and presented them with the opportunity to request a consultation or book an appointment for the procedure.

Results

This study set out to investigate if ad effectiveness is influenced by the extent to which the gender and age of the model depicted in an ad execution was congruent with the target audience. In order to test the hypotheses, 95% confidence intervals and an 'N - 1' chi squared test, as originally proposed by Pearson¹⁷ and recommended by Campbell¹⁸, were used to determine statistical significance ($\alpha = 0.05$). Accordingly, differences in click-through ratios with a p value less than 5%, were regarded as representing significant differences.

In the experiment, a total of 659,522 Facebook users were exposed to the ads (number of impressions). We recorded 1733 unique clicks on the ads, representing an overall click-through ratio for the whole campaign of 0.26%. The click-through ratios across the 16 combinations is shown in Table 2. Before turning to the hypotheses individually, some initial observations can be made.

Firstly, older users exhibited almost twice the click-through-rate of ads (0.36%) of younger users (0.18%). Furthermore, females clicked on a greater proportion of ads (0.31%) than males (0.23%). As shown in Table 2, older females are more likely than any other cohort to click-through the ad, regardless of which ad was being presented (0.47%). Further analysis shows that the difference between this CTR and the CTRs of the other three audiences is statistically significant ($p < 0.05$).

[Table 2 about here]

Secondly, as per Table 3, the ad treatment which elicited the greatest click-through, across user profiles, was the ad depicting a younger male model (0.32%) and again this CTR was significantly higher than that generated by the other three ad treatments ($p < 0.05$).

[Table 3 about here]

Turning now to the hypotheses, the first hypothesis of the study was that gender congruence will have a positive effect on advertising effectiveness (H1) and within this, two separate hypotheses were presented. The findings in relation to these hypotheses are presented in Table 4 below. It is shown that H1a was supported, in that men clicked on a significantly greater proportion of ads featuring a male model compared to a female model but that H1b was not supported, in that female users did not click on a significantly greater proportion of ads featuring a female model compared to a male model. As such, H1 cannot be fully supported.

[Table 4 about here]

The second hypothesis was that age congruence will have a positive effect on advertising effectiveness (H2). From Table 5 it can be seen that the first of the two associated hypotheses, H2a, was supported in that older users clicked on a significantly greater proportion of ads featuring an older model compared to a younger model. Similarly, H2b was supported in that younger users clicked on a significantly greater proportion of ads featuring a younger model compared to an older model. As such, the second hypothesis was supported.

[Table 5 about here]

The next hypotheses considered age and gender congruence together. It was firstly proposed that when the ad is both age and gender congruent, the click through rate is higher than with any other ad treatment (H3). Findings in relation to the sub-hypotheses contributing to H3 are shown in Table 6 and Figure 3. H3a was that older, female users will click on a significantly greater proportion of ads featuring an older, female model compared to any of the other three ad treatments. This was fully supported. H3b proposed that younger, female users will click on a significantly greater proportion of ads featuring a younger, female model compared to any of the other three ad treatments and this was also fully supported. H3c held that older, male users will click on a significantly greater proportion of ads featuring an older, male model compared to any of the other three ad treatments and it too was fully supported. Lastly, H3d was that younger, male users will click on a significantly greater proportion of ads featuring a younger, male model compared to any of the other three ad treatments and it also was fully supported. Overall, therefore, there is full support for H3, indicating that the most effective ad is one that is both age and gender congruent.

[Table 6 about here]

[Figure 3 about here]

The last set of hypotheses proposed that either gender or age congruency (but not both) is better than neither variable being congruent (H4). Within this, the first hypothesis is that when the ad is gender congruent but not age congruent, the click through rate is higher than if the ad is neither age nor gender congruent (H4a). The findings in relation to the associated

hypotheses are presented in Table 7 where it can be seen that none of four sub-hypotheses was supported and as such H4a cannot be supported.

[Table 7 about here]

The second hypothesis associated with H4 is that when the ad is age congruent but not gender congruent, the click through rate is higher than if the ad is neither age nor gender congruent. Findings in relation to this are shown in Table 8.

[Table 8 about here]

As per Table 7, none of the associated hypotheses find support. Indeed, one of the differences is significant but in the opposite direction to that proposed. So instead of older, male users clicking on a significantly greater proportion of ads featuring an older, female model than a younger, female model (H4biii) they clicked on a significantly greater proportion of ads featuring the younger, female model. As such, H4b cannot be supported. And moreover, the fourth hypothesis (H4) is not supported by the findings, thus indicating that gender congruency alone, without age congruency, does not produce better results. These findings are discussed next.

Discussion

The findings have yielded important new insights about the topic of personalisation in online advertising and content presentation and specifically on the effect of age and gender congruence on ad click through rates. The findings showed that older users proportionately

clicked on almost twice as many ads as younger users (0.36% vs. 0.18%). This may support other research that found that older people are more drawn to faces on a Web page than younger users.^{19, 20, 21} Also revealed was that older females, with a click-through rate of 0.47% are more likely than any other cohort to click-through the ad, regardless of which ad was being presented. The gender aspect of this finding supports previous studies that revealed that females showed a more positive attitude toward online ads and indicated a greater intention to click through and learn more than males.^{22, 23} Similarly, other research found that females were more likely to be drawn to photos on a Web page.¹⁹ Again, the results from our study appear to corroborate these past studies as our female cohort were statistically significantly more likely than our male cohort to click on an ad with facial imagery. And from both a gender and age perspective, it supports other research that found that females aged 50 and over have a 31.2% higher click through rate on ads than younger females (age 18-29).²⁴

A second key finding is that the ad treatment which elicited the greatest click-through (0.32%) across all user profiles was the ad depicting a younger male model. This would seem to support other researchers who argue that older models are less appealing than younger models²⁵ and relates to a belief held by some that featuring elderly models in advertising can alienate users.²⁶

Turning to the hypotheses of the study, the findings indicated that age congruence, regardless of gender congruence has a positive effect on advertising effectiveness. However, the proposition that gender congruence, regardless of age congruence, would have a positive effect was rejected. It was therefore instructive to drill down further into these variables to explore their individual effects and their potential cumulative effects.

There was clear, definitive support for the hypothesis that age and gender congruence together will have the most positive effect. It was found that an age and gender congruent ad was the most clicked on compared to any other treatment across the four audience segments. The last hypothesis is perhaps the most interesting and potentially useful. It was proposed that when the ad is either gender or age congruent, but not both, the click through rate would be higher than if neither variable is congruent. The clear conclusion is that this is not the case. Specifically, gender congruency with age incongruency does not produce better results and equally, age congruency with gender incongruency did not lead to higher click-through rates. Taken together, this study provides compelling evidence that age and gender congruence are not just complementary but actually require each other to serve any significant benefit.

Conclusion

This study clearly demonstrates that marketers who wish to improve click-through rates on social media or just indeed design content for users of their content ought to take into account both the age and gender congruency of the content and the target audience. Rather than having a single ad or content that all the target audience sees, it is recommended that a number of treatments are created with imagery tailored to reflect the age and gender of the recipient. In our study, ensuring the ad was both age and gender congruent led to almost a doubling in click-through rates for most of our cohorts. Using age or gender alone cannot be relied on to improve performance.

This study used multivariate testing of an advertisement campaign on the online social network Facebook to investigate the extent to which digital advertising, personalised to

specific age and gender groups demographics (age and gender congruent) influences user engagement and increases click through rates.

The study achieved a total of 659,522 impressions (i.e. number of users who were exposed to the personalised advertisements and had the opportunity to engage). Moreover, a total of 1,733 unique clicks were recorded. Using N-1 Chi-square testing, this study found that a combined age and gender congruency yielded statistically significantly greater click-through ratios in comparison to non-congruent (non-personalised) online advertisements ($p<0.05$).

As an example, the click through rates by younger male users increased by over threefold when a young-male model appeared in the imagery. The implication is that online content that is personalised to the user's age and gender demographic increases active user engagement.

This study indicates that the additional time taken by digital marketers and web developers to personalise content to reflect the age and gender of each user is a worthwhile and useful investment, given the relative computational ease with which online content can be customised for different user groups on an interactive platform.

Study Limitations

This study benefited from being based upon a real-life, real-time, online advertising campaign and thus, avoided the limitations of similar studies that rely on 'indirect findings'.

²⁷ Care was taken to ensure like-for-like comparisons could be made within the two-by-two

ad treatment/audience profile design. However, there are a number of factors that may be considered limitations.

First, while there is no reason to believe that the geographical location of the study - the Glasgow metropolitan area, a region of the UK - is atypical, the fact that the sample was drawn from such a specific region could be construed as limiting. Related to this, all the people featured in the ads were white. It is the case that the vast majority of people residing in the area chosen for this experiment are white; according to 2011 census data, over 88% of people living in 'Glasgow City' are white.²⁸

Our experiment was scheduled during a four-hour time period on a Sunday. Being limited to any single time period could inadvertently introduce bias by favouring one age or gender group over another. That said, all cohorts in our study did receive equal ad impressions, and so this issue was, to a great extent, legislated for.

This study used click-through rates as a measure of ad effectiveness. Previous studies have shown that women are more likely to click on ads to gather information, whereas males, being more task oriented, are more likely to click only when there is a 'pressing need'.^{29, 30}

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Table 1. Study hypotheses relating to gender congruence, age congruence and combined age and gender congruence.

Figure 1. Design content for the experiment.

Figure 2. Example ad treatments for ‘older female’.

Table 2. Click-through rate (CTR) by target audience profile across all ads.

Table 3. Click-through rate by ad treatment across all user profiles.

Table 4. Findings in relation to H1: Gender congruence will have a positive effect on advertising effectiveness.

Table 5. Findings relating to H2: Age congruence will have a positive effect on advertising effectiveness.

Table 6. Findings related to H3: When the ad is both age and gender congruent, the click through rate is higher than with any other ad treatment.

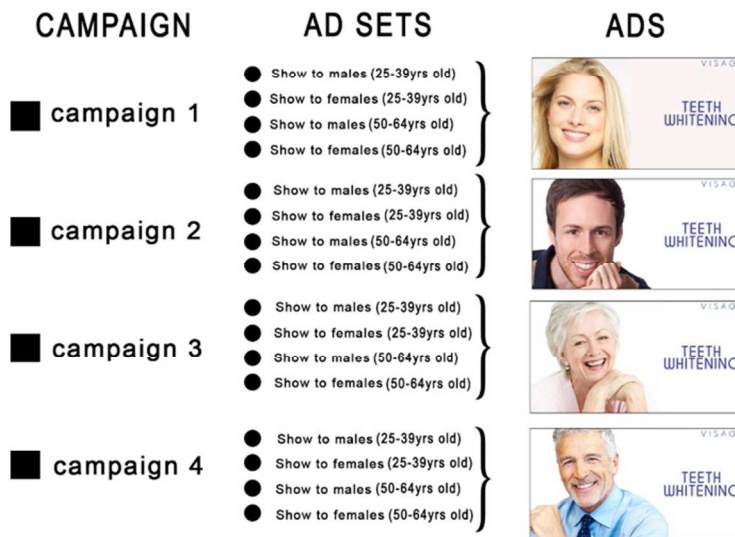
Figure 3. Click through rates for all ads.

Table 7. Findings related to H4a: When the ad is gender congruent but not age congruent, the click through rate is higher than if the ad is neither age nor gender congruent.

Table 8. Findings relating to H4b: H4b When the ad is age congruent but not gender congruent, the click through rate is higher than if the ad is neither age nor gender congruent.

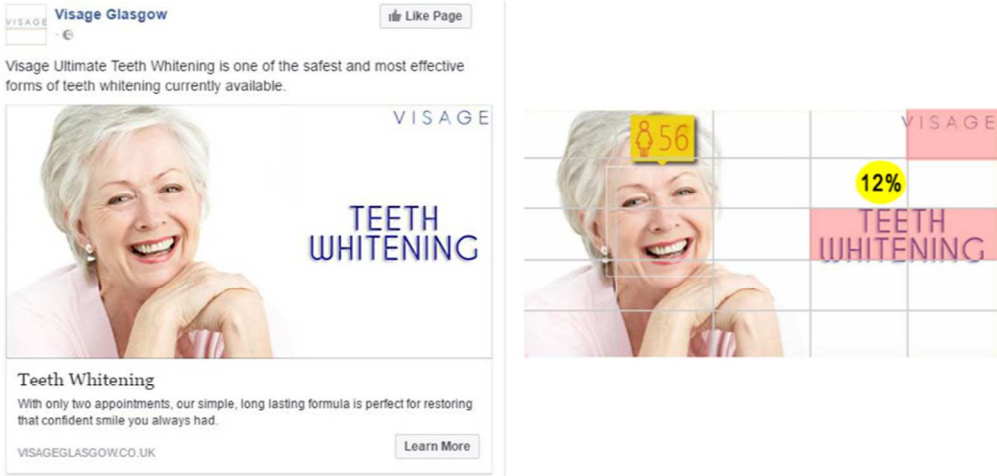
(a) H1 Gender congruence will have a positive effect on digital advertising effectiveness: H1a Male users will click on a significantly greater proportion of ads featuring a male model compared to a female model H1b Female users will click on a significantly greater proportion of ads featuring a female model compared to a male model
(b) H2 Age congruence will have a positive effect on digital advertising effectiveness: H2a Older users will click on a significantly greater proportion of ads featuring an older model compared to a younger model H2b Younger users will click on a significantly greater proportion of ads featuring a younger model compared to an older model
(c) H3 When the ad is both age and gender congruent, the click through rate is higher than with any other ad treatment : H3a Older, female users will click on a significantly greater proportion of ads featuring an older, female model compared to any of the other three ad treatments H3b Younger, female users will click on a significantly greater proportion of ads featuring a younger, female model compared to any of the other three ad treatments H3c Older, male users will click on a significantly greater proportion of ads featuring an older, male model compared to any of the other three ad treatments H3d Younger, male users will click on a significantly greater proportion of ads featuring a younger, male model compared to any of the other three ad treatments
(d) H4a When the ad is gender congruent but not age congruent, the click through rate is higher than if the ad is neither age nor gender congruent: H4ai Older, female users will click on a significantly greater proportion of ads featuring a younger, female model than a younger, male model H4aii Younger, female users will click on a significantly greater proportion of ads featuring an older, female model than an older, male model H4aiii Older, male users will click on a significantly greater proportion of ads featuring a younger, male model than a younger, female model H4aiv Younger, male users will click on a significantly greater proportion of ads featuring an older, male model than an older, female model
(e) H4b When the ad is age congruent but not gender congruent, the click through rate is higher than if the ad is neither age nor gender congruent: H4bi Older, female users will click on a significantly greater proportion of ads featuring an older, male model than a younger, male model H4bii Younger, female users will click on a significantly greater proportion of ads featuring a younger, male model than an older, male model H4biii Older, male users will click on a significantly greater proportion of ads featuring an older, female model than a younger, female model H4biv Younger, male users will click on a significantly greater proportion of ads featuring a younger, female model than an older, female model

Table 1. Study hypotheses relating to gender congruence, age congruence and combined age and gender congruence



Experiment design showing structure of campaigns, ad sets and ads

159x89mm (150 x 150 DPI)



Example ad: older, female.

159x76mm (150 x 150 DPI)

Audience profile	CTR (%)
Older females	0.47
Younger females	0.15
Older males	0.24
Younger males	0.21

Table 2. Click-through rate (CTR) by target audience profile across all ads.

Ad treatment	CTR (%)
Older female	0.26
Younger female	0.21
Older male	0.28
Younger male	0.32

Table 3. Click-through rate by ad treatment across all user profiles.

Hypothesis	Click-through rates (%)	Significance	Conclusion
H1a Male users will click on a significantly greater proportion of ads featuring a male model compared to a female model	User: Male Ad: Male = 0.29 Ad: Female = 0.15	$p < 0.05$	Supported
H1b Female users will click on a significantly greater proportion of ads featuring a female model compared to a male model	User: Female Ad: Female = 0.31 Ad: Male = 0.30	$p = 0.371$	Not supported

Table 4. Findings in relation to H1: Gender congruence will have a positive effect on advertising effectiveness.

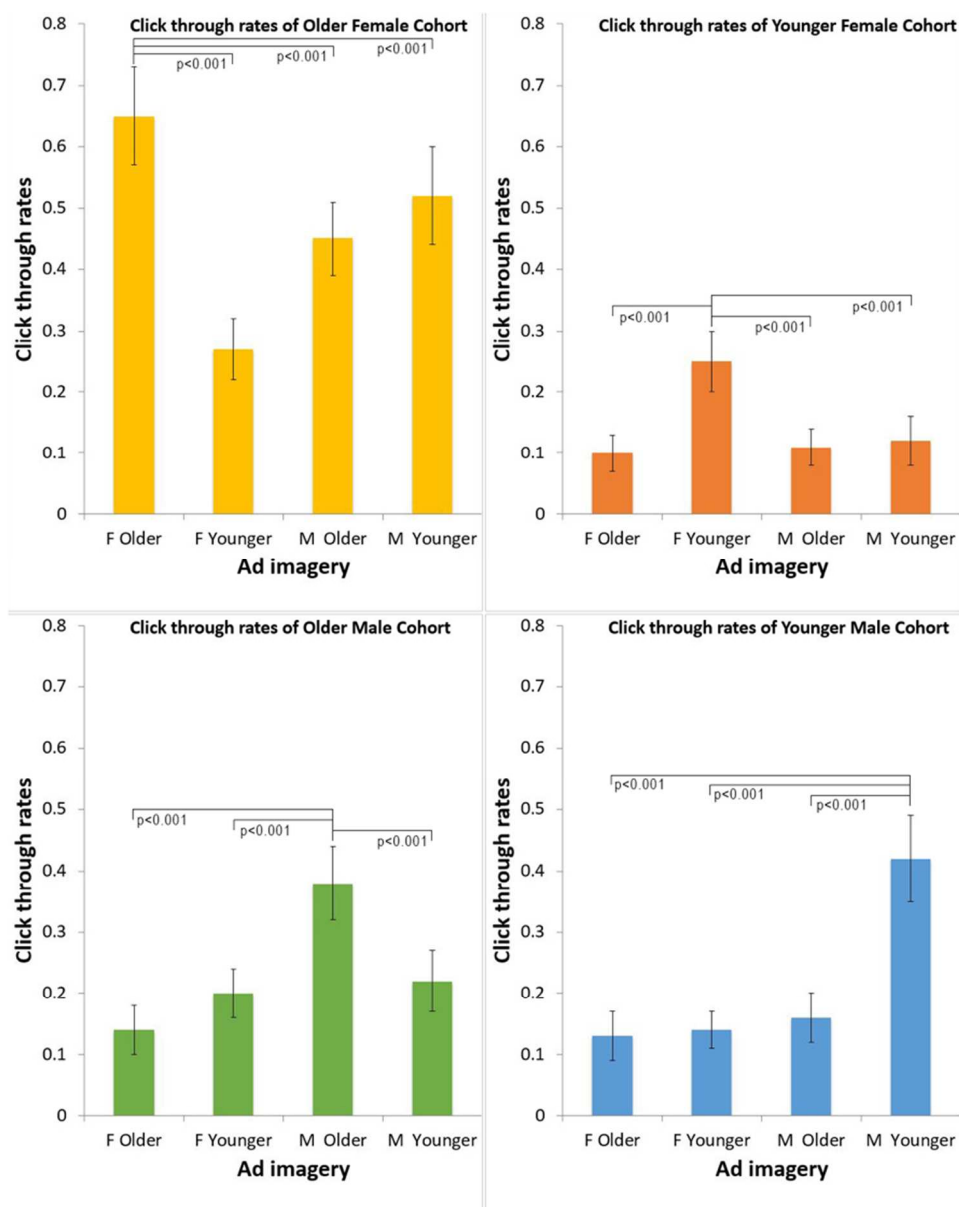
Hypothesis	Click-through rates (%)	Significance	Conclusion
H2a Older users will click on a significantly greater proportion of ads featuring an older model compared to a younger model	User: Older Ad: Older = 0.41 Ad: Younger = 0.29	p<0.05	Supported
H2b Younger users will click on a significantly greater proportion of ads featuring a younger model compared to an older model	User: Younger Ad: Younger = 0.23 Ad: Older = 0.12	p<0.05	Supported

Table 5. Findings relating to H2: Age congruence will have a positive effect on advertising effectiveness.

Hypothesis	Click-through rates (%)	Significance	Conclusion
H3a Older, female users will click on a significantly greater proportion of ads featuring an older, female model compared to any of the other three ad treatments	User: older, female Ad: older female = 0.65 Compared to:		Supported
	Ad: younger female = 0.27	p<0.05	
	Ad: older male = 0.45	p<0.05	
	Ad: younger male = 0.52	p<0.05	
H3b Younger, female will click on a significantly greater proportion of ads featuring a younger, female model compared to any of the other three ad treatments	User: younger female Ad: younger female = 0.25 Compared to:		Supported
	Ad: older female = 0.10	p<0.05	
	Ad: older male = 0.11	p<0.05	

	Ad: younger male = 0.12	p<0.05	
H3c Older, male users will click on a significantly greater proportion of ads featuring an older, male model compared to any of the other three ad treatments	User: older, male Ad: older male = 0.38 Compared to:		Supported
	Ad: older female = 0.14	p<0.05	
	Ad: younger female = 0.20	p<0.05	
	Ad: younger male = 0.22	p<0.05	
H3d Younger, male users will click on a significantly greater proportion of ads featuring a younger, male model compared to any of the other three ad treatments	User: younger, male Ad: younger male = 0.42 Compared to:		Supported
	Ad: older female = 0.13	p<0.05	
	Ad: younger female = 0.14	p<0.05	
	Ad: older male = 0.16	p<0.05	

Table 6. Findings related to H3: When the ad is both age and gender congruent, the click through rate is higher than with any other ad treatment



Cohort click through rates on the four different ads

149x188mm (150 x 150 DPI)

Hypothesis	Click-through rates (%)	Significance	Conclusion
H4ai Older, female users will click on a significantly greater proportion of ads featuring a younger, female model than a younger, male model	User: older female Ad: younger female = 0.27 Ad: younger male = 0.52	p<0.05	Not supported
H4aii Younger, female users will click on a significantly greater proportion of ads featuring an older, female model than an older, male model	User: younger, female Ad: older female = 0.10 Ad: older male = 0.11	p=0.659	Not supported
H4aiii Older, male users will click on a significantly greater proportion of ads featuring a younger, male model than a younger, female model	User: older, male Ad: younger male = 0.22 Ad: younger female= 0.20	p=0.559	Not supported
H4aiv Younger, male users will click on a significantly greater proportion of ads featuring an older, male model than an older,	User: younger male Ad: Older male = 0.16 Ad: Older female = 0.13	p=0.274	Not supported

female model			
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Table 7. Findings related to H4a: When the ad is gender congruent but not age congruent, the click through rate is higher than if the ad is neither age nor gender congruent

Hypothesis	Click-through rates (%)	Significance	Conclusion
H4bi Older, female users will click on a significantly greater proportion of ads featuring an older, male model than a younger, male model	User: older, female Ad: older male = 0.45 Ad: younger male = 0.52	p=0.173	Not supported
H4bii Younger, female users will click on a significantly greater proportion of ads featuring a younger, male model than an older, male model	User: younger, female Ad: younger male = 0.12 Ad: older male = 0.11	p=0.639	Not supported
H4biii Older, male users will click on a significantly greater proportion of ads featuring an older, female model than a younger, female model	User: older, male Ad: older female = 0.14 Ad: younger female= 0.20	p<0.05 (but opposite to hypothesised direction)	Not supported
H4biv Younger, male users will click on a significantly greater proportion of ads featuring a younger, female model than an older, female model	User: Younger male Ad: younger female = 0.14 Ad: Older female = 0.13	p=0.693	Not supported

Table 8. Findings relating to H4b: H4b When the ad is age congruent but not gender congruent, the click through rate is higher than if the ad is neither age nor gender congruent